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ABSTRACT

Twelve concepts utilized by Project I-C-E (Instruction-Curriculum-Environment) for integrating science, social studies, and language arts with environmental studies are elaborated in this booklet. The rationale for each concept is put forth together with a more detailed explanation of the concept. Topics considered include: energy, ecosystems, limiting environmental factors, water supply, clean air, distribution of natural resources, factors influencing land use, values and attitudes, the power of man, economics, decision making, and land stewardship. This work was prepared under an ESEA Title III contract. (BL)

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TWELVE MAJOR CONCEPT CATEGORIES

AND THEIR RATIONALE

by George Howlett

Project I-C-3
(Instruction-Curriculum)
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The Concepts and Their Rationale

Concept One: Energy from the sun, the basic source of all energy, is converted through plant photosynthesis into a form that all living things can use for life processes.

When we turn on an electric light switch, we may be able to mentally trace the source of this useful energy back to a generating station. We may even know that in most cases the energy comes by releasing the energy stored in fossil fuels. Very few of us conceive of the hydrogen bomb reaction of the sun as being the ultimate source of our electrical energy. Yet this sun, radiating light energy, is the source not only of the electrical energy of our modern world, but also of the very energy we need for body operation. Only the green plant can trap and store this energy. When light energy strikes the green plant the simple common compounds of water and carbon dioxide are transformed into an energy rich storage product, sugar. Some of the sugar undergoes transformation over geological time to energy storage products we call fossil fuels. Whether we use this energy stored by the green plant when eating plant products, when eating animals fed on plant products or when burning fossil fuels, we release this energy by using oxygen produced by the plant during sugar manufacture. We thus free carbon dioxide and water to recycle through the energy storage cycle to keep life systems operating.

Concept Two: All living systems interact among themselves and their environment, forming an intricate unit called an ecosystem.

We have seen in concept one that there is a dependency on the green plant for the operation of the energy cycle of life. But the green plant does not operate independently. It is dependent on the physical and biotic world in which it lives. Plants as food energy producers, animals as energy consumers and decay organisms recycling organic matter for plant use--all form part of a complex interacting biotic community. These organisms are specially adapted to living with each other within a physical realm which is itself a complex of interacting factors such as soil, climate, available light, season, water and oxygen supply, etc. Each biotic community type is different because its surrounding and physical factors vary. In addition, each community has its own influence on the physical surroundings. This creates a feedback situation known as the dynamic balance of nature. Constant change is part of the whole system. We call this complex of life and physical factors and their interactions an ecosystem.

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Just as on an electric light switch, we may be able to mentally trace the flow of energy back to a generating station. We may even know that in the case of fossil fuels, energy comes by releasing the energy stored in fossil fuels. Very much of the hydrogen bomb reaction of the sun as being the ultimate source of energy. Yet this sun, radiating light energy, is the source of the electrical energy of our modern world, but also of the very life of the body operation. Only the green plant can trap and store this energy. When energy strikes the green plant the simple common compounds of carbon dioxide and water are transformed into an energy rich storage product, sugar. This sugar undergoes transformation over geological time to energy storage in the form of fossil fuels. Whether we use this energy stored by the green plant in the form of plant products, when eating animals fed on plant products or when burning fossil fuels, we release this energy by using oxygen produced by the plant during photosynthesis. We thus free carbon dioxide and water to recycle through the system to keep life systems operating.

Living systems interact among themselves and their environment, forming an intricate unit called an ecosystem.

In concept one that there is a dependency on the green plant for the energy cycle of life. But the green plant does not operate in isolation; it is dependent on the physical and biotic world in which it lives. Energy producers, animals as energy consumers and decay organisms all matter for plant use--all form part of a complex interacting system. These organisms are specially adapted to living with each other in a realm which is itself a complex of interacting factors such as available light, season, water and oxygen supply, etc. Each biotic factor is different because its surrounding and physical factors vary. In turn, the community has its own influence on the physical surroundings. This situation known as the dynamic balance of nature. Constant interaction between the whole system. We call this complex of life and physical interactions an ecosystem.

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Concept Three: Environmental factors are limiting on the number of organisms living within their influence, thus each environment has a carrying capacity.

Recent space adventures have made us aware that our astronauts are dependent on a life support system which must be finely planned and engineered to achieve a safe and successful space voyage. We on earth live in a similar life support system. Because we have not yet treated this spaceship, Earth, with the foresight in planning that is done for space travelers, we may be pushing this system to the limits of its resistance. Each environmental factor is a strand in the web of life and when a strand breaks because pressure on it exceeds its capacity, the whole web is weakened and may break down. The best measure of the strength of an environmental strand is its ability to support a population of organisms. The weakest strand, of course, is the one that will limit the density of the population. We can destroy life's web by increasing population beyond the capacity of the limiting factors; for example, overgrazing a pasture. Also, we can change the resistance within life's web by altering the environmental structure as we do in polluting water.

Concept Four: An adequate supply of pure water is essential to life.

No life of which we know functions without water. Even a virus, basically a super molecule, is active only in the watery environment of living tissue. Each organism has adaptations for life in an environment that includes a certain water quantity and quality. The varied concentrations of wastes pouring from our industries and sewers change water quality so that native organisms are eliminated. Some of the new industrial compounds poured out are so strange that no organism can adjust. Man has changed the supply and quality of water in many areas without consideration for the quality of the biotic communities dependent on these waters. He even goes on changing water quality when it is of detriment to his own use of this water.

Concept Five: An adequate supply of clean air is essential for life.

Some of our commercially most useful organisms, the yeasts, can exist without air. In fact, as obligate anaerobes, they must carry on their active life processes in the absence of oxygen. But even these anomalous organisms depend on the energy-laden organic molecules such as the sugars produced by oxygen respiring green plants.

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An adequate supply of pure water is essential to life.

Without which we know functions without water. Even a virus, basically a particle, is active only in the watery environment of living tissue. Each organism has adaptations for life in an environment that includes a certain water quality. The varied concentrations of wastes pouring from our industries pollute the water quality so that native organisms are eliminated. Some of the chemical compounds poured out are so strange that no organism can adjust. We neglect the supply and quality of water in many areas without consideration of the biotic communities dependent on these waters. He even goes on to pollute the quality when it is of detriment to his own use of this water.

An adequate supply of clean air is essential for life.

Even the commercially most useful organisms, the yeasts, can exist without oxygen. Obligate anaerobes, they must carry on their active life processes without oxygen. But even these anomolous organisms depend on the energy molecules such as the sugars produced by oxygen respiring green plants.

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The green plant carries on respiration even as it photosynthesizes an excess of oxygen for animal respiration. Both plant and animal respiratory systems have evolved in an atmospheric condition predating man's inventions. We now see the damage to plant and animal communities resulting from industrial and automotive fumes and smogs. Some organisms are more sensitive to changes in air quality as seen in the death of the Ponderosa Pine in the mountains near Los Angeles. Our concern is not only with the lethal effects to sensitive organisms or to more tolerant organisms under disaster conditions, but also with the long term, low level toxicity which is cumulative to organisms such as man because of the changes our industrial culture has on air quality.

Concept Six: Natural resources are not equally distributed over the earth or over time, and greatly affect the geographic conditions and quality of life.

Before man's culture entered into the progression of life's history, climate, land form and mineral locations presented environmental conditions that only certain plant communities and their animal associates could tolerate and to which they could adapt. The geologic activities of erosion and mountain uplift have changed the land forms over time. Thus, plant communities were not always associated with the locations where man found them. Man is a most adaptable organism. His cultures have reached all regions of the earth, but until recent times even this has been by genetic adaptation to environmental conditions. Now as industrial man seeks to extract resources for his economic machine he must trade with people of other regions. Historically, the extraction of resources has often left the populations of those regions poorer as the extracting nations have been enriched. Even industrial man, with his capacity to modify the environment, is confounded when he moves to a pleasant place of living like California. He finds that he has overloaded the capacity of the region to absorb his wastes because of the special local distribution of land form in the Los Angeles Basin.

Concept Seven: Factors such as facilitating transportation, economic conditions, population growth, and increased leisure time have a great influence on changes in land use and centers of population density.

Consider two small settlements connected with the fur trade, one on Rock Island in Door County and the other at present day Chicago as they were several centuries ago. What makes these two sites so vastly different today? We see one located where

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the lake carrier, the railroad, the truck, the river barge and the airplane can bring and exchange goods from near and far. Having easily available the raw materials of agricultural produce, fuel, and ore and being close to the heartland of the agricultural market meant that a profitable manufactory could develop. Financial houses grew to provide the capital funds industry needed. The city fueled its own growth as early expansion increased the demand for services. As urban growth changes the natural site appearance, the urban man seeks to use his increased free time affluence and to return where he can linger in the rustic atmosphere his industry erased. Now this man invades the remote island, presently a park, to sample a way of life he cannot permit to remain where he carries on the activity of the economic man.

Concept Eight: Cultural, economic, social and political factors determine the structure of man's values and attitudes toward his environment.

Erich Fromm says of western and particularly of north American man: "Man has lost his central place, ...he has been made an instrument for the purpose of economic aims...he has been estranged from and has lost the concrete relatedness to his fellow men and to nature, ...he has ceased to have a meaningful life." We have come to live in a material, market oriented society which is conditioned to value things above life and person. Man has created the machine and is now owned by his own creation. Our advertising causes us to search out in satisfaction of artificially created fantasies. The economic system that benefits from satisfying our consumer demands has its own demands on the resource base. The political system is cemented to economics because it measures national health in terms of Gross National Product. It also sets our attitude to the land in the sense that our public lands were considered wild things waiting to be reduced to dominion. The Myth of Superabundance saturates our whole outlook. In one sense we do see ourselves as central to all creation. We believe it is our duty to go and conquer nature which has its existence only to satisfy our demands. How different this is from the Indian culture that demanded an individual apologize to the spirit of any being or place which he needed to use for satisfaction of necessary human activity.

Concept Nine: Man has the ability to manage, manipulate, and change his environment.

As man has advanced in cultural sophistication from the food gathering and hunting-fishing cultures still retained by some few people we refer to as aboriginal

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Man has the ability to manage, manipulate, and change his environment.

As man has advanced in cultural sophistication from the food gathering and hunting cultures still retained by some few people we refer to as aboriginal,

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his ability to change the environment has increased. Today we possess the unwanted capacity to destroy most life directly with the terrible power of atomic force. We are in awe of this terrible power. We are also becoming aware that a less dramatic destruction goes on under our command as we mindlessly pursue the "conquest of nature." We extract the plant resources, the life giving capacities of the soil, the minerals and fuel deposits. We fill the waters with foul wastes, the marshes with our used goods, the air with contaminants and the land itself with the artifacts of progress. We should not forget, however, that man also has the power, when possessed of wisdom, to wisely manage the land, to use his knowledge of the ways of natural systems for maintaining his artificial systems in balance with those systems.

Concept Ten: Short-term economic gains may produce long-term environmental losses.

In Governing Nature, E. F. Murphy states: "If it means the return of a pre-1945 North America, we have changed even the most hostile landscapes in order to make them serve current economic demands." Market oriented entrepreneurs seeking to maximize profit have traditionally operated with relatively short-term outlooks. We all see the fruit of the land dangling before our eyes and wish to grab it unconcerned about the future productivity of the land. We operate with a faith in the myth of scientific supremacy which suggests that technology will atone for our abuse of the land. There are long-term environmental and social costs to be paid when we consider environmental factors as unimportant and air, water and land as "free goods." These costs must be paid. Even now we pay them as we find environmental quality decreasing and our social problems on the increase.

Concept Eleven: Individual acts, duplicated or compounded, produce significant environmental alterations over time.

Adam Smith in The Wealth of Nations conceived the idea of "the invisible hand." He said that it was largely the individual merchant, intent on his own gain, who by his actions the aggregate directs the availability of goods to meet the demands of a market economy. This same invisible hand in the form of individual consumer decisions, guided by competitive prices and product availability, directs manufacturers to use more on the resources of nature to supply the market. Each supplier's decision to ignore the costs of maintaining environmental quality, so better to compete on the price schedule, has added to the present environmental damage. The individual consumer

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making decisions to buy, to dispose of consumed goods, to participate in political action for environmental causes has a great degree of control over further destruction to the land. If the aggregate of individuals love and respect the land as mother earth, these decisions will combine to solve present environmental problems and prevent more damage to earth's environment.

Concept Twelve: Private ownership must be regarded as a stewardship and should not encroach upon or violate the right of others.

Our Indian ancestors held that the land belonged to "the people." An individual could hold land during his lifetime, but he was to treat it as the mother spirit who nourished the people from ages past and would do so in the far distant future. We are charged with being custodians of creation, and are held responsible for the wise use of creation's bounties. If we consider ourselves masters of the earth, yet destroy the environment, then we are out of control, being not masters but slaves. In his Sand County Almanac, Aldo Leopold found the custodianship concept an ecological necessity. Individual man is part of the community of nature, interdependent with this community. The community of the land is the life support system for all including man. Leopold asks how a man might be considered a respected member of the human community when he commits crimes of abuse against the land. We should have our social consciousness extended to a concern not only for the relationships within the human community but also for the relationships between man and the total community of life. This Leopold calls the Land Ethic.

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I. Behavioral Objectives

A. Cognitive:

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